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On High Brightness Temperature of Pulsar Giant Pulses

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Abstract: A wide range of events observed at the giant pulses (high energy density, observed localization of giant pulses GPs relative to the average pulse, fine structure of GPs with duration up to some nanoseconds, observed circular polarization of GPs, correlation between the GP phase and the phase of the hard pulsar emission X-ray and gamma) can be explained from the viewpoint that the internal polar gap is a cavity-resonator stimulated by discharges and radiating through the breaks in the magnetosphere. The new results in this field [the electromagnetic (em) waves generation in the gap in the process of longitudinal acceleration in the electric field vanishing on the star surface, high frequency break in the spectrum as a result of switching off this generation, formation in this process a power-low spectrum with a high frequency (hf) break, the possibility determination of pulsar magnetic field by the hf break position, the difference between main pulse and inter pulse mechanism generation, quantization of em tornado rotation in the gap and appearance of the bands in the inter pulse spectrum, influence the high energy density in the gap on pair generation and position of the dead line in pulsars] are added in the intermediate epilogue.

Key words: Pulsars, giant pulses, inner gap, cavity-resonator, spark rotation, electromagnetic tornado.

Nomenclature

GP:	Giant pulse
hf:	High frequency
em:	Electromagnetic

Greek letters

ρ_{GJ}:	Density charge of Goldreich-Julian
Σ_{PC}:	Area of the polar cap

1. Introduction

Giant pulses (GPs), sporadically observed in a small number of pulsars[1], are a riddle which has not yet been solved [1-5]. GP is characterized by enormous flux density [6], extremely small pulse duration (down to a few nanoseconds) [7], presence of circular polarization of both directions [8], power distribution by energies [9], mainly location in the narrow window with respect to the average pulse position [10] and correlation between the GP phase and the phase of the hard pulsar emission (X-ray and γ-ray) [11, 12]. All these features fundamentally distinguish GPs from ordinary pulses[2]. Nevertheless, GP seems to be "a frequent, but rarely observed phenomenon inherent in all pulsars" [10]. A number of pulsars[3] emits anomalously intensive pulses [13] which by their properties seemingly do not differ from GPs. Trying to explain GPs by plasma mechanisms in magnetosphere in which different variants of two-stream instability are realized [14] needs considering strongly nonlinear effects such as modulation instability [15, 16], Zakharov plasma wave collapse (the more popular) [8], reconnection of the magnetic field lines [17, 18], induced scattering in narrow beams [5, 19].

When explaining the GPs in these works, we have seen that the pulsar is regarded as a "plasmic generator", a "device", in which the radiation processes are governed by different (nonlinear)

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[2]See also the works [43-48].

[3]B0809+74, B0823+26, B0834+06, B0943+10, B0950+08, B1133+16.